

STATISTICAL ELEVEN-MONTH WEATHER FORECASTING

Reference to Related Application

The present application claims the benefit of U.S. Provisional Patent Application No. 60/492,968, filed August 7, 2003, whose disclosure is hereby incorporated by reference in its entirety into the present disclosure

Field of the Invention

The present invention is directed to a technique, capable of implementation on a computer, for making weather predictions. The invention includes both the technique for doing so and business methods employing the technique to make predictions useful for retailers.

Description of Related Art

Retailers and similar businesses plan their business from last year's sales results, and Wall Street encourages this further by tracking their performance relative to the same period a year ago. Most companies are in some way impacted by weather, especially those that sell or produce seasonal merchandise.

Even companies that do not sell seasonal merchandise can be significantly affected by the weather, as consumers are impacted by the weather. An example would be a pizza parlor. Pizza is indirectly weather impacted because consumers call for a pizza delivery in inclement weather. Thus, more rain results in more business at a pizza parlor. Video rentals are weather impacted in a similar way. Inclement winter weather brings a boost to business, as bad weather limits outdoor activities, so consumers tend to remain indoors and watch television.

The location of the business also plays a role in the significance of weather. Big-box retailers are stand-alone destination locations that can be more impacted by weather than stores in a conventional enclosed mall. On a cold or rainy day, people can more easily justify a trip to

an enclosed mall, where they can eat, shop for multiple categories of items, or watch a movie, than they can with regard to a stand-alone retailer.

Statistically, weather repeats year-over-year in any given location less than 20% of the time. As an example, December 1993 was cold in New York; December 1994 was near record warm; in 1995 it was one of the coldest Decembers in 100 years; in 1996, near record warm. In 1997, the weather was “normal” (cooler). The government 30-year average is defined as “normal” weather. Unfortunately, it is an average of all the really cold and really warm months thereby making it a measure that rarely occurs. Like last year, “normal” occurs less than 20% of the time for any given location and time.

The December example above shows that very typically weather scenario plays havoc for most companies. For example, suppose that a merchant has sold many coats, jackets, boots and other winter items in New York in December 1993. After the season is over, the merchant will plan next year’s coat business. Unfortunately, most companies will simply look at last year’s sales and then plan up another 10%. Wall Street is somewhat to blame, as it demands growth. So the merchant heads to China in April the following year and buys a large number of coats, since it sold a large number last year. The coats (all 110% of them) arrive by boat in July are shipped to the distribution centers in August and pushed to the stores for the back-to-school season in September. Now they wait for the cold weather. Unfortunately, it never came in 1994, and now the merchant is stuck with an oversupply of coats. The solution is to mark it down and give it away to clear the merchandise. This eroded most profits for the coat merchant and resulted in a disappointing season. The merchant therefore plans very conservatively for the 1995 season and maybe changes the mix to light weight coats. December 1995 turns out to be

coldest December on record. The merchant sells out early and misses what would have been many sure sales. The result is a loss in both profits and good will.

Summary of the Invention

It is therefore an object of the invention to improve weather forecasting.

It is another object of the invention to improve weather forecasting over periods of time useful to allow retailers and similar businesses to plan purchases.

5 To achieve the above and other objects, the present invention is based on the following discovery. The inventor analyzed between 109 and 118 years (depending on location) of temperature data and found a very clear pattern for 260 major markets across the country. The markets are listed in the Appendix. An illustrative example is shown in Fig. 1 for Eastern New York.

10 The analysis showed the following. First, the weather seldom repeats. If last year was warm (above the normal monthly mean November temperature of 39.5° , which is indicated by the line labeled *N*), the next year is less likely to be warm or as warm; if last year was cold (below the normal line *N*), the following year is less likely to be as cold. Second, normal seldom occurs.

15 These charts very clearly show just how much risk there is for retailers, manufacturers, consumer packaged goods companies and even the pizza makers who plan their business off last year.

 Based on the premise that the weather repeats less than 20% of the time (80% of the time it does something different from last year) and most companies plan off last year, the inventor
20 has developed a process (formula) by which to produce a forecast for next year (rolling 11-months out by week) that would be a more accurate measure of future weather vs assuming last year's weather would be the same.

In Fig. 1, the dashed line labeled *H* (42.2°) depicts 1 sigma standard deviation above normal, and the dashed line labeled *C* (36.8°) shows 1 sigma standard deviation below normal. The average monthly swing in temperatures year-over-year is about 5° with the greatest monthly year-over-year swing 10°-15°.

5 The next step in the process was to confirm that the above monthly trends would hold true at a weekly level, and they do. So if a week was really hot or cold last year in November, the chances that the same week in the future would be hot/cold was still only about 20% likely to repeat.

10 Weekly normal (based on 109-118 years of data) temperatures values for each of the 260 major markets were created for every month. As an example, the 39.5° monthly normal November mean temperature in Eastern New York would be broken down to a standard 4-week retail November calendar (week ending date Saturdays):

Week ending November 8, 2003, normal weekly mean temperature value is 43°.

Week ending November 15, 2003, normal weekly mean temperature value is 41°.

15 Week ending November 22, 2003, normal weekly mean temperature value is 38°.

Week ending November 29, 2003, normal weekly mean temperature value is 36°.

The initial monthly process to forecast for next year used the following rules:

If last year November was 2-sigma above the 109-year mean, the forecast for next year would be 7° colder.

20 If last year was between 1 and 2-sigma above the 109-year mean, the forecast would be 1 sigma colder.

If last year was less than 1-sigma above the 109-year mean, the forecast would be the normal weekly mean temperature.

If last year was less than 1-sigma below the 109-year mean, the forecast would be the normal weekly mean temperature.

If last year was between 1 and 2-sigma below the 109-year mean, the forecast would be 1 sigma warmer.

5 If last year was 2-sigma below the 109-year mean, the forecast for next year would be 7° warmer.

If last year was within 1° of normal, then take the preceding two-year average for that week and then apply the above rules. So if the year prior was warm and this year normal then the forecast would be toward colder.

10 The monthly process outlined above was refined in 2002-2003 to allow for the creation of weekly temperature and precipitation forecasts using standard mathematical formulas built off the general findings at the monthly level.

Brief Description of the Drawings

A preferred embodiment of the present invention will be set forth in detail with reference to the drawings, in which:

Fig. 1 shows a plot of temperature data used to demonstrate the present invention;

5 Fig. 2 shows a flow chart of a procedure for forecasting temperature;

Fig. 3 shows a coding scheme used for graphical representations of temperature forecasts;

Fig. 4 shows a flow chart of a procedure for forecasting precipitation;

Fig. 5 shows a coding scheme used for graphical representations of precipitation forecasts;

10 Fig. 6 shows a schematic diagram of a system on which the preferred embodiment can be implemented; and

Figs. 7 and 8 show sample publications for presentation of the forecasts.

Detailed Description of the Preferred Embodiment

A preferred embodiment of the present invention will be set forth in detail with reference to the drawings.

First, the process for weekly temperature prediction will be performed. Then, the process for weekly precipitation will be performed.

The process for weekly temperature prediction will be explained with reference to the flow chart of Fig. 2.

1. (Step 202) Calculate the actual weekly mean temperature values for each of the 260 markets for last year. If forecasting for June 2004 this process would begin once June 2003 is complete. Adding up the 7 max temperatures and 7 minimum temperatures and dividing by 14 calculate actual weekly mean temperatures.

Note: all aggregations of temperature are applied to a standard retail calendar with a week ending date Saturday.

2. (Step 204) Using the predefined weekly normal mean temperatures (based on a 30-year average for each location, each week) calculate the delta between actual and normal for last year by week by location.

3. Once the delta from last year actual and normal is determined we can calculate the weekly mean temperature forecast for next year using one of the following equations (3.a. – 3.d). First, we determine whether the delta value calculated above is greater than equal to two degrees above normal, less than or equal to two degrees below normal, or within two degrees of normal (Step 206). Depending on that determination, one of the following is carried out.

a. If last year was equal to or greater than 2° above normal, complete the following calculation (Step 208):

$$\text{LY Tact} - [(\text{LY Tact} - \text{T norm}) \times .75] = \text{FORECAST}$$

b. If last year was between 2° and -2° of NORMAL, complete the following calculation (Step 210):

$$(\text{LLY Tact} + \text{LY Tact}) / 2 = 2 \text{ year average temperature}$$

5 Compare that result with normal.

1) If the 2-year average temperature is 2° or more above normal, use equation 3.a (Step 208).

2) If the 2-year average temperature is still between 2° and -2° of normal, use normal as the forecast (Step 212).

10 3) If the 2-year average temperature is -2° or more below normal, use equation 3.c (Step 214).

c. If the 2-year average temperature for the week in question is -2° or more BELOW NORMAL complete the following calculation:

$$(\text{LLY Tact} + \text{LY Tact}) / 2 + [\text{ABS} (((\text{LLY Tact} + \text{LY Tact}) / 2) - \text{T norm}) \times .75] = \text{FORECAST}$$

15

d. If last year was equal to or less than -2° BELOW NORMAL, complete the following calculation (Step 216):

$$\text{LY Tact} + [\text{ABS} ((\text{LY Tact} - \text{T norm}) \times .75)] = \text{FORECAST}$$

20 4. The forecast value is calculated for the 4 or 5 weeks that make up the month for each of the 260 locations using the above formulas (Step 218). Forecast values are depicted in visual deliverables both as a value and as a delta from the year prior, using a coding scheme such as that of Fig. 3.

The weekly precipitation prediction process will now be explained with reference to the flow chart of Fig. 4.

5. Calculate the total weekly precipitation for each of the 260 markets for last year (Step 402). Actual total weekly precipitation is calculated by adding up the 7 daily totals for the week.

5 Note: all aggregations of temperature are applied to a standard retail calendar with a week ending date Saturday.

6. Calculate the delta between last year's actual total weekly precipitation and the normal value (Step 404).

7. Once the delta from last year actual and normal is determined we can calculate the weekly total precipitation forecast for next year using one of the formulas below (7.a. – 7.d).
10 First, we determine whether last year's value is 125% or more above normal, 75% or less below normal, or within 75% and 125% of normal (Step 406). Depending on that determination, one of the following is carried out.

a. If last year total weekly precipitation was 125% or more above normal, complete the
15 following calculation (Step 408):

$$\text{LY Pact} - [(\text{LY Pact} - \text{P norm}) \times .75] = \text{FORECAST}$$

b. If last year total weekly precipitation was between 125% and 75% of NORMAL, complete the following calculation (Step 410):

$$(\text{LLY Pact} + \text{LY Pact}) / 2 = 2 \text{ year average precipitation}$$

20 Compare the result to normal.

1) If the 2-year average precipitation is still 125% or more above normal, use equation 7.a (Step 408).

2) If the 2-year average precipitation is still between 125% and 75% of normal, use the normal weekly value as the forecast (Step 412).

3) If the 2-year average precipitation total is 75% or more below normal, go to equation 7.c (Step 414).

5 c. If the 2-year average precipitation total for the week in question is 75% or more below normal, complete the following calculation:

$$\text{((LLY Pact + LY Pact)/2 + [ABS (((LLY Pact + LY Pact)/2) - P norm) x .75]) = FORECAST}$$

10 d. If last year was 75% or more below normal, complete the following calculation (Step 416):

$$\text{LY Pact + [ABS ((LY Pact - P norm) x .75)] = FORECAST}$$

15 8. The precipitation forecast value is calculated for the 4 or 5 weeks that make up the month for each of the 260 locations using the above formulas (Step 418). Forecast values are depicted in visual deliverables both as a value and as a delta from the year prior using the coding scheme of Fig. 5.

Fig. 6 shows a block diagram of a system on which the preferred embodiment can be carried out. The system 600 receives the raw weather data 602 on any suitable medium or transmission link. The system includes a computer 604 having a microprocessor 606, RAM 608 and persistent storage (e.g., a hard drive) 610 for storing both the weather data 602 and calculation results. The computer 604 can be connected by any suitable communication system to a page setter 612 and printer 614 for producing hard-copy weather reports for mailing to clients. Alternatively, the calculation results can be directly input into a client's system 616 via a virtual private network or the like.

Examples will be given.

EXAMPLE 1

Last year was 81° in Philadelphia for the week ending July 6th, 2002. Normal weekly temperature is 75°. Use equation 3.a.:

$$5 \quad \text{LY Tact} - [(\text{LY Tact} - \text{T norm}) \times .75] = \text{FORECAST}$$

$$81 - [(81-75) \times .75] =$$

$$81 - 4.50 =$$

= 76.5° is the FORECAST for next year this same week (weekending 7/5/2003)

EXAMPLE 2

10 This past week ending January 18th, 2003, was 25° in Philadelphia. Normal weekly temperature is 32°. Use equation 3.d.:

$$\text{LY Tact} + [\text{ABS} ((\text{LY Tact} - \text{T norm}) \times .75)] = \text{FORECAST}$$

$$25 + [\text{ABS} ((25-32) \times .75)] =$$

$$25 + [\text{ABS} (-7) \times .75] =$$

$$15 \quad 25 + 5.25 =$$

= 30.3° is the FORECAST for next year this same week in Philadelphia

EXAMPLE 3

This past week ending January 18th, 2003, there was 0.25" of precipitation. Normal weekly precipitation is 0.83". Using equation 7.d.:

$$20 \quad \text{LY Pact} + [\text{ABS} ((\text{LY Pact} - \text{P norm}) \times .75)] = \text{FORECAST}$$

$$0.25 + [\text{ABS} ((0.25-0.83) \times .75)] =$$

$$0.25 + 0.435 =$$

= 0.69" is the FORECAST for next year this same week in Philadelphia

ACCURACY: Is measured both directionally and if the forecast is closer to actual vs assuming last year.

On average, the directional accuracy of the WEEKLY forecasts over the last 13 years has been 76%. In 2003 to date the weekly directional accuracy is 80%. So, if the forecast implied this November would be colder than last year and it was that is considered an accurate directional forecast. Repeat the process for all markets, all weeks and divide by the total possible correct forecasts to arrive at a percent accuracy value.

The second measure of accuracy is if the forecast is closer to the specific weekly mean temperature than last year. If last year was 45° and our forecast was 38° and actual came in anywhere from 41° or colder we would score it a hit. This is the more strict measure of accuracy. On average this is 68% accurate which is a 3-time improvement over assuming last year. Over the past 13 years this process has been within +/- 3° during the volatile winter months and within +/- 2° during the summer months.

Precipitation shows less skill due to a lot of factors (it rains everywhere but the airport, spotty thunderstorms, tropical systems, etc.). Precipitation tracks at 61% directionally correct.

This process is in an experimental stage for monthly snowfall trends and shows some skill at a monthly level.

VALUE: With nearly a 4-time more accurate view of future temperature weather trends and three time more accurate precipitation trends by week retailers and manufacturers can plan their business with a lot more intelligence when making key decisions on purchasing product, manufacturing goods, allocating merchandise, timing promotions, timing advertising events, timing marketing activities, labor scheduling, logistics planning (air, ship, barge, rail, truck), etc.

Most weather companies provide a forecast relative to normal, which is tough for a retailer to plan from. In order to plan using a forecast that said it will be warmer than normal next winter they would have to know what “normal” sales are, an impossible measure for most companies. By providing the forecast relative to last year in a weekly aggregate that matches their calendar (i.e. it will be 7° colder than last year for week ending X), they can better plan their seasonal business.

PRODUCTS: As noted above with respect to Fig. 6, calculation results can be output to clients in several ways. Hard-copy reports include a trend report and a sales and marketing planner. Digital data feeds for input into retailers and manufacturers forecasting and planning environments.

Business Applications using these long-range products include the following:

An 11-month ahead weather trend report provides visual representations of the forecast through maps and charts on the expected weather trends across the nation by week and month. These visuals allow retailers and manufacturers to make adjustments on how much product to buy, where to allocate it, when to time a promotion or advertising and when to get out of a product with a markdown. A sample is shown in Fig. 7.

The 11-month ahead weather trend sales and marketing planner provides a time-series view of the forecast by location across many months. This product allows advertising agencies to simply pick out the best weeks to time campaigns with favorable weather and stay clear of the unfavorable periods. Advertising in unfavorable weather for the particular product is ineffective and a waste of advertising dollars. Timing price incentives when the weather is not favorable for sales will help to spur consumer demand. A sample is shown in Fig. 8.

Digital forecasts 11-months ahead by week by location can be imported into business planning, forecasting and replenishment systems. These systems factor in many variables like price, advertising, marketing, economy, last year's sales but seldom factor in a weather component. The weather piece is arguably one of the most important variables for seasonal goods that rely on favorable weather for product sales.

While a preferred embodiment and variations thereon have been disclosed, those skilled in the art who have reviewed the present disclosure will readily appreciate that other embodiments can be realized within the scope of the invention. For example, numerical values are illustrative rather than limiting, as are disclosures of specific hardware and of specific page layouts for printed reports. Therefore, the present invention should be construed as limited only by the appended claims.

Appendix: List of Markets

Market Name	State	Call Sign	Airport Name
Aberdeen	SD	KABR	Aberdeen / Aberdeen Regional Airport
Abilene	TX	KABI	Abilene / Abilene Regional Airport
Akron-Canton	OH	KCAK	Akron / Akron-Canton Regional Airport
Alamosa	CO	KLHX	La Junta / La Junta Municipal Airport
Albany	GA	KABY	Albany / Southwest Georgia Regional Airport
Albany	NY	KALB	Albany / Albany County Airport
Albuquerque	NM	KABQ	Albuquerque / Albuquerque International Airport
Alexandria	LA	KESF	Alexandria / Alexandria Esler Regional Airport
Allentown	PA	KABE	Allentown / Lehigh Valley International Airport
Alpena	MI	KAPN	Alpena / Alpena County Regional Airport
Altoona	PA	KAOO	Altoona / Altoona-Blair County Airport
Amarillo	TX	KAMA	Amarillo / Amarillo International Airport
Asheville	NC	KAVL	Asheville / Asheville Regional Airport
Astoria	OR	KAST	Astoria / Astoria Regional Airport
Athens	GA	KAHN	Athens / Athens Airport
Atlanta	GA	KATL	Atlanta / Hartsfield Atlanta International Airport
Atlantic City	NJ	KACY	Atlantic City / Atlantic City International Airport
Augusta	GA	KAGS	Augusta / Bush Field
Austin	TX	KAUS	Austin / Austin-Bergstrom International Airport
Bakersfield	CA	KBFL	Bakersfield / Meadows Field Airport
Baltimore	MD	KBWI	Baltimore / Baltimore-Washington International Airport
Bangor	ME	KBGR	Bangor / Bangor International Airport
Baton Rouge	LA	KBTR	Baton Rouge / Baton Rouge Metropolitan / Ryan Field
Beaufort	SC	KNBC	Beaufort / Marine Corps Air Station
Beaumont	TX	KBPT	Beaumont / Port Arthur / Southeast Texas Regional Airport
Beckley	WV	KBKW	Beckley / Raleigh County Memorial Airport
Bellingham	WA	KBLI	Bellingham / Bellingham International Airport
Billings	MT	KBIL	Billings / Billings Logan International Airport

Binghamton	NY	KBGM	Binghamton / Binghamton Regional Airport
Birmingham	AL	KBHM	Birmingham / Birmingham International Airport
Bismarck	ND	KBIS	Bismarck / Bismarck Municipal Airport
Boise	ID	KBOI	Boise / Boise Air Terminal
Boston	MA	KBOS	Boston / Logan International Airport
Bowling Green	KY	KBWG	Bowling Green / Bowling Green-Warren County Regional Airport
Bozeman	MT	KBZN	Bozeman / Gallatin Field
Bridgeport	CT	KBDR	Bridgeport / Sikorsky Memorial Airport
Bristol	TN	KTRI	Bristol / Johnson / Kingsport / Tri-City Regional Airport
Brownsville	TX	KBRO	Brownsville / Brownsville / South Padre Island International Airport
Buffalo	NY	KBUF	Buffalo / Greater Buffalo International Airport
Burlington	IA	KBRL	Burlington / Burlington Regional Airport
Burlington	VT	KBTV	Burlington / Burlington International Airport
Burns	OR	KBNO	Burns / Burns Municipal Airport
Butte	MT	KBTM	Butte / Bert Mooney Airport
Cape Girardeau	KY	KPAH	Paducah / Barkley Regional Airport
Caribou	ME	KCAR	Caribou / Caribou Municipal Airport
Casper	WY	KCPR	Casper / Natrona County International Airport
Cedar City	UT	KCDC	Cedar City / Cedar City Municipal Airport
Cedar Rapids	IA	KCID	Cedar Rapids / Cedar Rapids Municipal Airport
Champaign	IN	KHUF	Terre Haute / Terre Haute International Airport-Hulman Field
Charleston	SC	KCHS	Charleston / Charleston Air Force Base
Charleston	WV	KCRW	Charleston / Yeager Airport
Charlotte	NC	KCLT	Charlotte / Charlotte / Douglas International Airport
Charlottesville	VA	KCHO	Charlottesville / Charlottesville-Albemarle Airport
Chattanooga	TN	KCHA	Chattanooga / Lovell Field
Cheyenne	WY	KCYS	Cheyenne / Cheyenne Airport
Chicago/O'Hare	IL	KORD	Chicago / Chicago-O'Hare International Airport
Cincinnati	OH	KCVG	Covington / Cincinnati / Cincinnati / Northern Kentucky International Airport
Clarksburg	WV	KCKB	Clarksburg / Clarksburg Benedum Airport

Cleveland	OH	KCLE	Cleveland / Cleveland-Hopkins International Airport
Colorado Springs	CO	KCOS	Colorado Springs / City Of Colorado Springs Municipal Airport
Columbia	MO	KCOU	Columbia / Columbia Regional Airport
Columbia	SC	KCAE	Columbia / Columbia Metropolitan Airport
Columbus	OH	KCMH	Columbus / Port Columbus International Airport
Columbus	GA	KCSG	Columbus / Columbus Metropolitan Airport
Concord	NH	KCON	Concord / Concord Municipal Airport
Concordia	KS	KCNK	Concordia / Blosser Municipal Airport
Corpus Christi	TX	KCRP	Corpus Christi / Corpus Christi International Airport
Dallas	TX	KDFW	Dallas / Fort Worth / Dallas / Fort Worth International Airport
Dayton	OH	KDAY	Dayton / Cox Dayton International Airport
Daytona Beach	FL	KDAB	Daytona Beach / Daytona Beach Regional Airport
Del Rio	TX	KDRT	Del Rio / Del Rio International Airport
Denver	CO	KDEN	Denver / Denver International Airport
Des Moines	IA	KDSM	Des Moines / Des Moines International Airport
Detroit	MI	KDTW	Detroit / Detroit Metropolitan Wayne County Airport
Dickinson	ND	KDIK	Dickinson / Dickinson Municipal Airport
Dodge City	KS	KDDC	Dodge City / Dodge City Regional Airport
Dothan	AL	KDHN	Dothan / Dothan Regional Airport
Dover	DE	KDOV	Dover Air Force Base
Dubuque	IA	KDBQ	Dubuque / Dubuque Regional Airport
Duluth	MN	KDLH	Duluth / Duluth International Airport
Eau Claire	WI	KEAU	Eau Claire / Chippewa Valley Regional Airport
El Paso	TX	KELP	El Paso / El Paso International Airport
Elkins	WV	KEKN	Elkins / Elkins-Randolph County-Jennings Randolph Field
Elmira	NY	KELM	Elmira / Elmira / Corning Regional Airport
Ely	NV	KELY	Ely / Ely Airport
Erie	PA	KERI	Erie / Erie International Airport
Eugene	OR	KEUG	Eugene / Mahlon Sweet Field
Evansville	IN	KEVV	Evansville / Evansville Regional Airport
Fargo	ND	KFAR	Fargo / Hector International Airport

Farmington	NM	KFMN	Farmington / Four Corners Regional Airport
Flagstaff	AZ	KFLG	Flagstaff / Flagstaff Pulliam Airport
Flint	MI	KFNT	Flint / Bishop International Airport
Florence	SC	KFLO	Florence / Florence Regional Airport
Fort Myers	FL	KFMY	Fort Myers / Page Field
Fort Smith	AR	KFSM	Fort Smith / Fort Smith Regional Airport
Fort Wayne	IN	KFWA	Fort Wayne / Fort Wayne International Airport
Fort Worth	TX	KFTW	Fort Worth / Meacham International Airport
Fresno	CA	KFAT	Fresno / Fresno Air Terminal
Gainesville	FL	KGNV	Gainesville / Gainesville Regional Airport
Glasgow	MT	KGGW	Glasgow / Glasgow International Airport
Goodland	KS	KGLD	Goodland / Renner Field
Grand Forks	ND	KGFK	Grand Forks / Grand Forks International Airport
Grand Island	NE	KGRI	Grand Island / Central Nebraska Regional Airport
Grand Junction	CO	KGJT	Grand Junction / Walker Field
Grand Rapids	MI	KGRR	Grand Rapids / Gerald R. Ford International Airport
Great Falls	MT	KGTF	Great Falls / Great Falls International Airport
Green Bay	WI	KGRB	Green Bay / Austin Straubel International Airport
Greensboro	NC	KGSO	Greensboro / Piedmont Triad International Airport
Greenville	SC	KGSP	Greer / Greenville-Spartanburg Airport
Gulfport	MS	KGPT	Gulfport / Gulfport-Biloxi Regional Airport
Harrisburg/Middletown	PA	KCXY	Harrisburg / Capital City Airport
Hartford	CT	KBDL	Windsor Locks / Bradley International Airport
Hatteras	NC	KHSE	Hatteras / Mitchell Field
Hattiesburg	MS	KHBG	Hattiesburg / Bobby L Chain Municipal Airport
Helena	MT	KHLN	Helena / Helena Regional Airport
Houghton Lake	MI	KHTL	Houghton Lake / Roscommon County Airport
Houston	TX	KIAH	Houston / Houston Intercontinental Airport
Huntington	WV	KHTS	Huntington / Tri-State Airport
Huntsville	AL	KHSV	Huntsville / Huntsville International / Jones Field
Huron	SD	KHON	Huron / Huron Regional Airport

Indianapolis	IN	KIND	Indianapolis / Indianapolis International Airport
International Falls	MN	KINL	International Falls / Falls International Airport
Jackson	KY	KJKL	Jackson / Carroll Airport
Jackson	MS	KJAN	Jackson / Jackson International Airport
Jackson	TN	KMKL	Jackson / McKellar-Sipes Regional Airport
Jacksonville	FL	KJAX	Jacksonville / Jacksonville International Airport
Jamestown	NY	KJHW	Jamestown Automatic Weather Observing / Reporting System
Jamestown	ND	KJMS	Jamestown / Jamestown Municipal Airport
Jonesboro	AR	KJBR	Jonesboro / Jonesboro Municipal Airport
Kalispell	MT	KFCA	Kalispell / Glacier Park International Airport
Kansas City	MO	KMCI	Kansas City / Kansas City International Airport
Key West	FL	KEYW	Key West / Key West International Airport
Knoxville	TN	KTYS	Knoxville / McGhee Tyson Airport
Lafayette	IN	KLAF	Lafayette / Purdue University Airport
Lake Charles	LA	KLCH	Lake Charles / Lake Charles Regional Airport
Lander	WY	KLND	Lander
Lansing	MI	KLAN	Lansing / Capital City Airport
Laredo	TX	KLRD	Laredo International Airport
Las Vegas	NV	KLAS	Las Vegas / McCarran International Airport
Lewiston	ID	KLWS	Lewiston / Lewiston-Nez Perce County Airport
Lexington	KY	KLEX	Lexington / Blue Grass Airport
Lincoln	NE	KLNK	Lincoln / Lincoln Municipal Airport
Little Rock	AR	KLIT	Little Rock / Adams Field
Los Angeles	CA	KLAX	Los Angeles / Los Angeles International Airport
Louisville	KY	KSDF	Louisville / Standiford Field
Lubbock	TX	KLBB	Lubbock / Lubbock International Airport
Lynchburg	VA	KLYH	Lynchburg / Lynchburg Regional Airport
Macon	GA	KMCN	Macon / Middle Georgia Regional Airport
Madison	WI	KMSN	Madison / Dane County Regional-Truax Field
Mansfield	OH	KMFD	Mansfield / Mansfield Lahm Municipal Airport
Marquette	MI	KMQT	Marquette

Medford	OR	KMFR	Medford / Rogue Valley International Airport
Memphis	TN	KMEM	Memphis / Memphis International Airport
Meriden	MS	KMEI	Meridian / Key Field
Miami	FL	KMIA	Miami / Miami International Airport
Midland	TX	KMAF	Midland / Midland International Airport
Miles City	MT	KMLS	Miles City / Frank Wiley Field Airport
Milwaukee	WI	KMKE	Milwaukee / General Mitchell International Airport
Minneapolis	MN	KMSP	Minneapolis / Minneapolis-St. Paul International Airport
Minot	ND	KMOT	Minot / Minot International Airport
Missoula	MT	KMSO	Missoula / Missoula International Airport
Mobile	AL	KMOB	Mobile / Mobile Regional Airport
Moline	IL	KMLI	Moline / Quad-City Airport
Monroe	LA	KMLU	Monroe / Monroe Regional Airport
Montgomery	AL	KMGH	Montgomery / Dannelly Field
Montpelier	VT	KMPV	Barre / Montpelier / Knapp State Airport
Muskegon	MI	KMKG	Muskegon / Muskegon County Airport
Nashville	TN	KBNA	Nashville / Nashville International Airport
New Orleans	LA	KMSY	New Orleans / New Orleans International Airport
New York	NY	KLGA	New York / La Guardia Airport
Newark	NJ	KEWR	Newark / Newark International Airport
Norfolk	NE	KOFK	Norfolk / Stefan Memorial Airport
Norfolk	VA	KORF	Norfolk / Norfolk International Airport
North Platte	NE	KLBF	North Platte / North Platte Regional Airport
Oklahoma City	OK	KOKC	Oklahoma City / Will Rogers World Airport
Olympia	WA	KOLM	Olympia / Olympia Airport
Omaha	NE	KOMA	Omaha / Eppley Airfield
Orlando	FL	KMCO	Orlando / Orlando International Airport
Ottumwa	IA	KOTM	Ottumwa / Ottumwa Industrial Airport
Palm Springs	CA	KPSP	Palm Springs / Palm Springs Regional Airport
Panama City	FL	KPFN	Panama City / Panama City-Bay County International Airport
Parkersburg	WV	KPKB	Parkersburg / Wood County Airport / Gill Robb Wilson Field

			Airport
Pendleton	OR	KPDT	Pendleton / Eastern Oregon Regional At Pendleton Airport
Pensacola	FL	KPNS	Pensacola / Pensacola Regional Airport
Peoria	IL	KPIA	Peoria / Greater Peoria Regional Airport
Philadelphia	PA	KPHL	Philadelphia / Philadelphia International Airport
Phoenix	AZ	KPHX	Phoenix / Phoenix Sky Harbor International Airport
Pierre	SD	KPIR	Pierre / Pierre Regional Airport
Pittsburgh	PA	KPIT	Pittsburgh / Pittsburgh International Airport
Pocatello	ID	KPIH	Pocatello / Pocatello Regional Airport
Portland	ME	KPWM	Portland / Portland International Jetport
Portland	OR	KPDX	Port Isabel / Portland International Airport
Prescott	AZ	KPRC	Prescott / Love Field
Price	UT	KPUC	Price / Carbon County Airport
Providence	RI	KPVD	Providence / Theodore Francis Green State Airport
Pueblo	CO	KPUB	Pueblo / Pueblo Memorial Airport
Quincy	IL	KUIN	Quincy / Quincy Regional-Baldwin Field Airport
Raleigh	NC	KRDU	Raleigh / Durham / Raleigh-Durham International Airport
Rapid City	SD	KRAP	Rapid City / Rapid City Regional Airport
Redding	CA	KRDD	Redding / Redding Municipal Airport
Reno	NV	KRNO	Reno / Reno Tahoe International Airport
Richmond	VA	KRIC	Richmond / Richmond International Airport
Roanoke	VA	KROA	Roanoke / Roanoke Regional Airport
Rochester	MN	KRST	Rochester / Rochester International Airport
Rochester	NY	KROC	Rochester / Greater Rochester International Airport
Rockford	IL	KRFD	Rockford / Greater Rockford Airport
Roswell	NM	KROW	Roswell / Roswell Industrial Air Center Airport
Sacramento	CA	KSAC	Sacramento / Sacramento Executive Airport
Salem	OR	KSLE	Salem / McNary Field
Salt Lake City	UT	KSLC	Salt Lake City / Salt Lake City International Airport
San Angelo	TX	KSJT	San Angelo / Mathis Field
San Antonio	TX	KSAT	San Antonio / San Antonio International Airport

San Diego	CA	KSAN	San Diego / San Diego International-Lindbergh Field
San Francisco	CA	KSFO	San Francisco / San Francisco International Airport
Santa Barbara	CA	KSBA	Santa Barbara / Santa Barbara Municipal Airport
Santa Fe	NM	KSAF	Santa Fe / Santa Fe County Municipal Airport
Sarasota	FL	KSRQ	Sarasota / Bradenton / Sarasota-Bradenton International Airport
Savannah	GA	KSAV	Savannah / Savannah International Airport
Scottsbluff	NE	KBFF	Scottsbluff / Heilig Field
Scranton	PA	KAVP	Wilkes-Barre-Scranton / Wilkes-Barre / Scranton International Airport
Seattle-Tacoma	WA	KSEA	Seattle / Seattle-Tacoma International Airport
Sheridan	WY	KSHR	Sheridan / Sheridan County Airport
Shreveport	LA	KSHV	Shreveport / Shreveport Regional Airport
Silver City	NM	KTCS	Truth Or Consequences / Truth Or Consequences Municipal Airport
Sioux City	IA	KSUX	Sioux City / Sioux Gateway Airport
Sioux Falls	SD	KFSD	Sioux Falls / Foss Field
South Bend	IN	KSBN	South Bend / South Bend Regional Airport
Spokane	WA	KGEG	Spokane / Spokane International Airport
Springfield	MO	KSGF	Springfield / Springfield Regional Airport
Springfield	IL	KSPI	Springfield / Capital Airport
St. Cloud	MN	KSTC	St. Cloud / St. Cloud Municipal Airport
St. Louis	MO	KSTL	St. Louis / Lambert-St. Louis International Airport
Syracuse	NY	KSYR	Syracuse / Syracuse Hancock International Airport
Tallahassee	FL	KTLH	Tallahassee / Tallahassee Regional Airport
Tampa	FL	KTPA	Tampa / Tampa International Airport
Toledo	OH	KTOL	Toledo / Toledo Express Airport
Topeka	KS	KTOP	Topeka / Philip Billard Municipal Airport
Traverse City	MI	KTVK	Traverse City / Cherry Capital Airport
Tucson	AZ	KTUS	Tucson / Tucson International Airport
Tulsa	OK	KTUL	Tulsa / Tulsa International Airport
Tupelo	MS	KTUP	Tupelo / Tupelo Regional Airport
Valentine	NE	KVTN	Valentine / Miller Field

Victoria	TX	KVCT	Victoria / Victoria Regional Airport
Waco	TX	KACT	Waco / Waco Regional Airport
Washington	DC	KDCA	Washington DC / Reagan National Airport
Washington/Dulles	VA	KIAD	Washington DC / Washington-Dulles International Airport
Waterloo	IA	KALO	Waterloo / Waterloo Municipal Airport
Wausau	WI	KAUW	Wausau / Wausau Downtown Airport
West Palm Beach	FL	KPBI	West Palm Beach / Palm Beach International Airport
Wichita	KS	KICT	Wichita / Wichita Mid-Continent Airport
Wichita Falls	TX	KSPS	Wichita Falls / Sheppard Air Force Base
Williamsport	PA	KIPT	Williamsport / Williamsport-Lycoming County Airport
Williston	ND	KISN	Williston / Sloulin Field International Airport
Wilmington	NC	KILM	Wilmington / New Hanover International Airport
Wilmington	DE	KILG	Wilmington / New Castle County Airport
Winnemucca	NV	KLOL	Lovelock / Derby Field Airport
Worcester	MA	KORH	Worcester / Worcester Regional Airport
Yakima	WA	KYKM	Yakima / Yakima Air Terminal
Youngstown	OH	KYNG	Youngstown / Youngstown-Warren Regional Airport
Yuma	AZ	KNYL	Yuma / Marine Corps Air Station